Modifications of Jet Fragmentation Function Due to Medium-Induced Effects Studied with ALICE Detector at LHC

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In ultra-relativistic heavy-ion collisions hot dense matter is created on an extremely short timescale. In order to probe this partonic medium we investigate a well accepted (in p+p) technique of jet analysis. At very early stages of the collision, high q^2 transfer in elastic collisions between partons results in high energy partons propagating transversely through the medium.

While traversing the medium, the parton ineracts with the surrounding medium, losing energy via gluon radiation, modifying both its energy and direction. The energy loss of the propagating parton is thought to be indicative of the energy density of the medium. The exact nature of these effects are model dependent and the measurement of these effects in experiment can contribute to the theoretical understanding of the produced high energy and density nuclear medium.

To demonstrate the ability of the ALICE experiment to measure these effects using ALICE-TPC charged particle tracking and the electromagnetic energy deposition in the ALICE-EMCal, we ran Monte-Carlo simulations of quenched and unquenched jets and embedded them inside HIJING [1] simulations of central Pb+Pb collisions at the nominal LHC energy of $\sqrt{s_{NN}} = 5.5TeV$. These combined events were then analysed using a full simulation of the ALICE detector.

Both quenched and unquenched jets were simulated with PYTHIA [2] tuned to results from the D0 experiment at Fermilab. The simple model of medium modification of jets involved the superposition of unmodified lower-energy jets. This model for medium effects is supported by pQCD calculations [3]. Fig. 1 shows the fraction of energy contained within the cone for unmodified (100GeV) and modified jets constructed from the superposition of 80 and 20 GeV jets.

We reconstruct jets using a modified-UA1 jetfinder algorithm [4]. This has been documented elsewhere, for details see [5]. The biases in the jet reconstruction process were investigated and are well understood.

We display in Fig. 2 the results of reconstruction of the fragmentation function for the two types of jets representing quenched and unquenched cases. The medium modification manifests itself through a softening of the fragmentation function. The reconstruction of the fragmentation functions is precise and changes of this type and magnitude can be measured.

We have demostrated that if this model of jet quenching is correct, ALICE will be sensitive to these medium modifications. This will allow insight into the internal structure of the medium through which the partons propagated.

[1] X.N. Wang and M. Gyulassy, Phys. Rev D**4**4, 3501 (1991(.

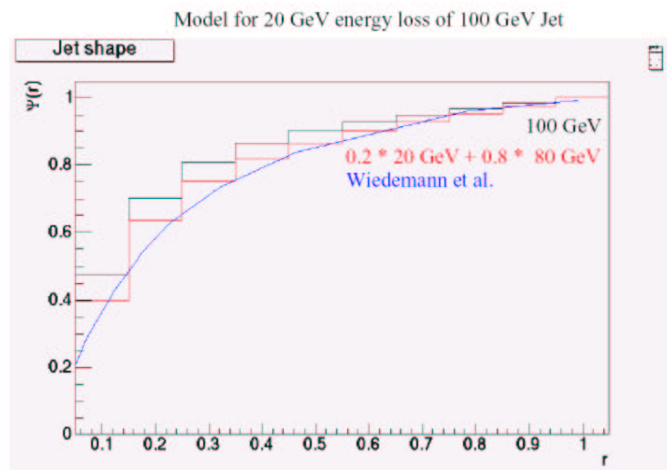

FIG. 1: Jet energy distribution in cone.

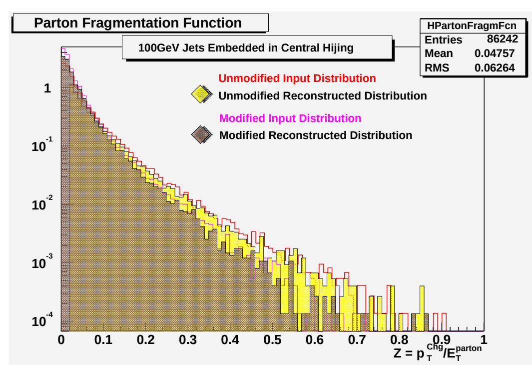

FIG. 2: Input and reconstructed fragmentation functions for unmodified jets and modified jets.

[2] T. Sjostrand, Computer Physics Commun. 82 (1994) 74
[3] C.A. Salgado and U.A. Wiedemann, hep-ph/0302184.
[4] W. Christie and K. Shestermanov, STAR Note 196.
[5] Report: Jetfinding with the ALICE Experiment at the LHC.